3-1-1996

Significance that a learning tool to enhance the understanding of the principles of printing has an effect on the productivity of color laser copier/ printer operators

AnnMarie Scamacca

Significance that a learning tool to enhance the understanding of the principles of printing has an effect on the productivity of color laser copier/printer operators.

by AnnMarie Scamacca

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
School of Printing Management and Sciences in the College
of Imaging Arts and Sciences of the Rochester Institute of Technology

February, 1996

Thesis Advisor: Joseph L. Noga

School of Printing Management and Sciences

Rochester Institute of Technology

Rochester, New York

Certificate of Approval

Master's Thesis

This is to certify that the Master's Thesis of

AnnMarie Scamacca

With a major in Printing Technology

has been approved by the Thesis committee as satisfactory

for the thesis requirement for the Master of Science degree

at the convocation of

March 1996

date

Thesis Committee:

Joseph L. Noga

Thesis Advisor

Joseph L. Noga

Graduate Program Coordinator

C. Harold Goffin

Director

Copyright Page

Significance that a learning tool to enhance the understanding of the principles of printing has an effect on the productivity of color laser copier/printer operators

February, 1996

Acknowledgments

It is my distinct pleasure to thank a select group of individuals who have provided me with unbounded encouragement towards completion of this thesis project, endless time when I felt I needed a direction, as well their honest opinions. I feel privileged to have had the opportunity to work with these outstanding professionals in their field: Professor Joe Noga, Professor Chuck Layne, Professor Frank Romano, and Lawrence Link.

It should not go unrecognized to publicly offer my gratitude to the participants of this study. Without their dedication, the project could never have been successfully completed. It was gratifying to conclude this study knowing that each operator received benefit in their participation.

Even though there was a clear understanding that this study was conducted completely independently from the company in which I am employed, I appreciate the support and encouragement that I have received from my employer, as well as all of my co-workers, throughout the efforts to complete this thesis project.

Table of Contents

List of Tables

List of Figures

Abstract

As the complexity of laser color copiers/printers evolve in this fast-paced, technological, quick-print industry, the amount of printing knowledge that is required to operate these devices is considerably declining. Advancements in the color laser printing arena are expanding every day. With the introduction of more precocious color printing units coupled with an infinite number of features, a broader market of users becomes available. Increasingly, non-traditional printing users are becoming involved with color copier/printer devices. There are several reasons why this infusion is taking place. Foremost, the technology now exists to convert "ordinary" black pages into full color documents. Secondly, there is a cost savings by bringing prepress work in-house. The cost of entering this market is decreasing as a result of color copiers/printers becoming available to those that could not afford color previously. Finally, there are users who simply want to invest in new technologies.

User interfaces on the color laser printers are becoming more icon-driven to simplify the operation of these devices. The amount of experience an operator needs to run a device is minimal. There is an immense amount of technology that is performing many of the calculations and adjustments behind the scene for the users. The problem still exists of what operators do if they need to further adjust output to meet a customer's request. An understanding of the principles of printing would provide an operator with the necessary background to satisfy customers' varying requirements.

The purpose of this thesis was to confirm that knowledge of the principles of printing would increase the productivity of color laser copier/printer operators. The major component of this research was in establishing, conducting, and analyzing the effects a customized learning tool had on the productivity of color copier/printer operators. The hypothesis stated that the learning tool would assist each operator with:

- increasing the total output on their device
- reducing the amount of waste generated in trying to produce successful output pages
- increasing job satisfaction
- and reducing the job run-length

A group of ten key operators were selected to partake in the study. An indepth study was conducted to capture their critical learning needs as they related to the color copier/printer operation. From the needs of the operators, a customized learning tool (training class) was created and provided to each operator. Total ouput, generated waste, job satisfaction, and job run-length were analyzed before and after the training was delivered. It was determined that the learning tool did have a significant effect on all four components of this researcher's components of productivity: total output, generated waste, job satisfaction and job run-length.

Knowing the functions and theoretical principles of a device greatly reduced the amount of time it took to run jobs as well as decreased the amount of wasted pages in trying to obtain quality output. The length of time it took to complete a job was significantly reduced as well as the amount of stress the operator endured in the operation

of the device. For example, an understanding of additive and subtractive color supplied these operators with the knowledge to adjust the color toner levels to comply with customers' request to have output look "more red." One operator stated that it took him *several* guesses as to what buttons to push on the device to achieve the correct output before he learned about color theory. He was lucky if it took him *several* attempts of running a job before he obtained the output that his customer was looking for. This caused him much stress and many wasted output pages. The information he learned about color theory provided him the background he needed to understand a customer's job before wasting paper and consumables trying to run it.

Chapter One

Introduction

"Scientists and engineers often speak of the "half-life." Half of what we know today will be obsolete in ten years and half of what we need to know is not yet presently available."[1] We can see the "half-life" phenomenon take form in the Graphic Arts Industry at this time. Technology is rapidly changing. Advancements in computers, software and telecommunications have not only migrated a portion of traditional printing from the pressroom onto the desktop: a whole new market has emerged that demands short-run, affordable color. What one may have called an industry standard has now become a way of the past. For example, the many hours of manual labor that was required in prepress operations has been greatly reduced on desktop computers. Businesses are competing for the most advanced products and the most powerful features to create premium output. Non-printing companies are even entering the printing marketplace with innovative designs to simplify the production of color output. These constant changes are forcing management to look at ways to keep their businesses informed and up to date. "There is a growing need to retrain individuals already employed in the printing business in order to take advantage of the new technology that requires new and different skills."[2] It was stated at the 1993 Annual Association of Graphic Arts Training Conference (AGAT) that approximately 75% of workers today will need some form of retraining by the year 2000.[3] A critical factor for an individual printing company's success during the decade of the

nineties will be a company's ability to attract and maintain a competent motivated work force that is large enough and versatile enough to produce a quality product, cost-effectively, and the situation is likely to get worse before it gets better.[4]

The major processes used for printing, publishing and packaging are lithography, gravure, flexography, letterpress and screen printing. These are all plate, or pressure (impact) printing processes that use plates or some form of image carrier and pressure between the image carrier and the substrate, usually paper, to reproduce the image.[5] Many of the newer Graphic Arts Technologies have acquired concepts from the traditional printing processes. The resulting environment is nothing more complex than plug and play. Businesses differentiate themselves by investing in a more user-friendly climate, which, in fact, decreases the present level of knowledge necessary to use these products. The message is being heard loud and clear. Even though it is not intentional, an understanding of some of the fundamental printing theories are no longer necessary: the equipment will perform all tasks for the operator. This author sympathizes with a company trying to get ahead, trying to make a profit, and trying to devise products that are easier to use: however, "idiot proofing" a product should be included in a product that has little variation in its output.[6] A printing device has many controls and variables. Without an understanding of what processes are taking place within the device, there is no sure way to control output. Let the author repeat that the Graphic Arts Industry is highly subjective. Not only is there variation because of the machine intricacy, there is also a fluctuation in personal preferences.

Another downfall of the plug and play devices is that products are not being fully utilized. Some features that took thousands of dollars to create, sit idol in a machine because the user does not truly understanding their function. Time is often wasted trying to figure out how to get certain features to work. More often than not, a user gets faced with a situation where they know what they want their output to look like, but have no idea how to achieve the results. The machine gets blamed for technically being broken and the end user does not get the output they desire. "Business loses billions annually in waste, lost productivity and reduced competitiveness."[7] Unfortunately, through all of this technological change, there has not been formal, concrete direction in creating industry standards that standardize the features and functions of specific devices.

How information is presented

There are several training and education programs in place, which provide the industry with the information needed to keep up with the technological changes that are taking place. There is a distinct difference between education and training. "Education involves the development of generalized knowledge and skills in artificial, off-the-job situations, whereas training refers to on-the-job development of those specific knowledge and skills required for competent performance."[8]

This author has encountered such "informational events" in both training and educational capacities and has had many favorable as well as unfavorable experiences with both. There is a tendency for these sessions to be directed toward a general audience. You take your chances on whether or not the training or education fits ones particular needs.

Training often makes the assumption that the audience has a basic understanding of the topic; whereas, education provides fundamentals, but is often not specific enough to enhance an individuals' job. "Information unto itself does little or nothing. It is only a value when comprehended, manipulated, integrated, and in short-learned... to amass the resources required and address the problems inherent to reaching and achieving the potential of a learning society will represent a challenge that we have never faced."[9]

It is the belief of the author that a learning tool needs to be customized based upon distinct users/customers. Berelson and Steiner define learning as "Changes in behavior that result from previous behavior in a similar situation. Mostly, but by no means always, behavior also becomes demonstrably more effective and more adaptive after the exercise than it was before. In the broadest terms, learning refers to the effects of experience, either director or symbolic, on subsequent behavior."[10] Isolating topics that are needed based upon what the people need for their job versus a canned training program or a class that teaches a specific educational theory can significantly improve the productivity of a particular technical device. The user group's needs must be recognized and analyzed before any learning tool is established. "Learning occurs when a stimulus is associated with a response"[11] It is this customized tool which will address the distinct issues that are needed by a specific audience.

Getting people trained and educated is extremely difficult, not to mention the cost that is associated with both techniques. Training and education do not seem to take the precedence that they should in introducing a new technology. There is a phenomenal cost

associated with such endeavors; however, "we cannot escape the fact that whether or not we have organized (or unorganized) programs of training, where no training exists, learning is taking place by trial and error, resulting in wasted money and products."[12]

Statement of the Problem

At present there is a large gap that has yet been acknowledged by the Graphic Arts Industry between new technology and how much of this technology is actually understood by its users. Because the Graphic Arts Industry spans many market segments, this author's research will focus on non-impact printing, specifically, the quick-print industry. The devices that will be the center of the focus are the laser color copiers/printers. The machines are characterized with 600 dpi, they are toner based and have scanning capability. With the emergence of extremely technical color printing devices that are "easy" to operate, there has been little regard given to the knowledge necessary for optimal performance by their operators. The Graphic Arts Industry is highly subjective. A large degree of variability exists in the quick print industry due in part to the distinct opinion of each diverse user as well as the amount of printing experience each customer has. What one customer might accept one may loath. This creates a situation in which the operator must have the knowledge to adjust both input and output. Being able to customize outputs would give a greater edge in this color copier/printer industry; however, an understanding of some of the fundamentals of printing are thus required.

"During the second World War, training became an absolute necessity due to our very urgent need for survival. At the present time, with the economy at a low point, we

are again faced with a problem of mobilizing our efforts to bring about a revitalized industry work force."[12] We must again take control of the technology our society has created by working with the technological innovations: not in competing with them.

This study included a theoretical basis and review of the literature pertaining to the quick print industry. In both of these sections there is reference to training sessions, education, and learning. There are several ways of providing information. This author feels there is a distinct difference among the methods. The common trait among all is that standing alone, each method is not enough to provide employees with what they need for successful job performance. Without analyzing participants' learning needs and without the participants holding a working knowledge of the principles of printing, color copying printing devices may not be performing to their capacity. "...up until now, the integrating component in the graphic arts industry have been the people... I'd say that people are still the most important ingredient in any prepress operation. Well informed, perceptive and thoughtful people will always be the key to a profitable, successful implementations of technology."[13]

Endnotes

1. Gandleman, David, and James Walsh. Accepting Change and the Training of an Industry Labor Force. Pittsburgh, Pennsylvania: GATF, 1992.

2. Kelly, Edward, and William Lamparter. "Industry Training and Education." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

3. Breeden, Wanda J. "How to Get Top Management Involved in Training." AGAT Conference, 1993.

4. Kelly, Edward, and William Lamparter. "Industry Training and Education." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

5. Bruno, Michael H. "Printing Process Trends." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

6. Filipcyak, Bob. "Customer Education: Some Assembly Required." Training December 1991: 31-35.

7. Breeden, Wanda J. "How to Get Top Management Involved in Training." AGAT Conference, 1993.

8. "A Timely Advantage." American Printer May 1992: 59-64.

9. Brenson, 1984

10. Berelson, Bernard, and Steirner. Human Behavior: An Inventory of Scientific Findings. USA: Haicourt, Cruse and World, Inc., 1964.

11. This, Leslie. "Results Oriented Training Designs." Planning and Management. Proceedings of the Sixth National Conference on Communications Technology in Education and Training. 1984, Silver Springs, Maryland.

12. Gandleman, David, and James Walsh. Accepting Change and the Training of an Industry Labor Force. Pittsburgh, Pennsylvania: GATF, 1992.

13. McMillan, Tom. "Technology Marches On." Color Publishing July/August 1994: 4.

Terminology

In an attempt to reduce any confusion as to the meaning of terms that are used in this thesis study, the author has supplied a listing of specific terms that are used throughout the following study.

1. Analysis Phase: the act and process of separating any material or abstract entity into its essential features and their relations to one another.
2. Cost of quality: the cost of internal and external failure.
3. Design Phase: comparison of the present versus the desired stage of the company is compared and contrasted, then an initiative can commence towards a plan of action.
4. Development Phase: test objectives and course content are combined into a draft learning package.
5. Downtime: the state of the printing device when it is unable to be used to produce output by the operator. Not including mechanical problems.
6. Evaluation Measurements: includes four types: reactions, learning, behavior, results...
7. External Validity: external threats ask whether you can get the same benefits if you use a program with different people in a different setting.
8. Education: involves the development of generalized knowledge and skills in artificial, off-the-job situations.
9. Flexography: a rotary relief printing process in which the image carrier is a flexible rubber or photopolymer plate.
10. Formative evaluation: deals with constant modification to a program, striving for perfection.
11. Gravure: industrial intaglio printing in which an image is transferred from a sunken surface.
12. Goal: the end results that we strive to achieve, structured guidance towards accomplishing the mission, generally strategic.
13. Instructional Systems Development Model (ISD): developed for the military to combat the pressures of military superiority and readiness. To ensure that the workers are both

trained accurately and are fully able to perform their assigned duties to the best of their abilities.

14. Intaglio: transferring an image from a sunken surface.

15. Internal Validity: internal threats ask whether your X in fact made a difference in the setting in which you tried it.

16. Job Inventory: what employees think they should know to improve their job performance. A comprehensive picture of job tasks and an assessment as to which of these skills the employees do not know.

17. Letterpress: process that prints from a raised or relief surface.

18. Lithography: transfer of an image from a flat surface by chemistry.

19. Objective: defines specifically how the goals will be achieved, important that values, methods and ground rules are specified up-front, objectives should be stated for each module... knowing where they are going will better help them get there more easily.

20. Performance Terms: describe what the trainee will be able to do , given or denied with the tools, working aids, assistance, supervision and physical environment in which he/she will perform, will state instructional intent, distinctly descries how sound the trainee must perform.

21. Personal Analysis: a concentrated effort to gather information about the individual employee such as job satisfaction.

22. Production Phase: validate, produces and distributes the final learning module.

23. Summative evaluation: uses data to make a final conclusion about the success of a program.

24. Screen Printing: transferring an image by allowing ink to pass through an opening or stencil.

25. Substrate: any base material used in the printing processes to receive an image transferred from a printing plate; common substrates are paper, foil, fabric and plastic sheets.

26. Task Analysis: concerned with precisely what jobs and tasks the employees feel are most critical for job success.

27. Traditional Printing: the process of manufacturing multiple copies of graphic images.

28. Training: refers to on-the-job development of specific knowledge and skills required for competent performance.

29. Waste: output of the printing device that can not be "sold" to the customer.

Chapter Two

Theoretical Basis of the Study

Often, training programs are "copied" from one group to the next simply because of their successful reputation. These programs become faddish; whereby the program is in existence solely because of the success of another group; however, a truly auspicious program should vary based upon the structure of the company, the type of business, and most importantly, the people that perform the work. For example, a dynamic environment such as a scientific lab would not benefit from having the same training program as that delivered in a more bureaucratic bank setting. The two types of people involved in each industry are very different from each other and would require distinct training needs. "In the face of rapidly changing markets and technologies, organizations must make periodic adjustments in their mode of operation to survive."[1]

Before any training program can be established; prior to any classroom curriculum finding its way into a syllabus; and in advance of each and every learning tool being developed, a method of determining participants' learning requirements is crucial for the success of a learning program. No guarantee can be provided to those schedules that do not take into consideration the audience, environment and history of the participating group.[2]

There are several instructional system models in existence today. This author has decided to focus on one specific archetype. The United States Navy and Marine Corps

has done a particularly impressive job in producing properly trained and educated personnel using a model that they have perfected, which is called The Instructional Systems Development Model, ISD. It was enhanced by the military to combat the "...pressures of military superiority and readiness."[3] Within a world of intense competition for dominance and control, the military has focused much of its energies on training its members. In a naval shipyard, the technicians who repair and equip the Navy vessel are crucial to the success of the craft's operations. Without the proper skills, there would be no guarantee that the Navy craft would be readied for combat. "As a result, military education and training specialists have become pioneers in the design, development, and application of instructional systems technology. "[4] The main objective of the Instructional Systems Development Model, ISD, is to ensure that the workers are both trained accurately and fully able of performing their assigned duties to the best of their abilities. The ISD has been used in Navel bases for several years all over the world. Modifications have been made to customize the learning based upon the specific group. The model itself has been used to organize the steps needed to establish a successful learning curriculum. The components of the model are broken down into five distinct categories: analysis, design, development, production, and evaluation.

Analyze

Analysis is defined as the act and process of separating any material or abstract entity into its essential features and their relations to one another. This provides a description of how something or someone is functioning or behaving or performing.[5] The

main component that can be obtained from analysis is the difference between what we perceive to be the facts and the actual facts themselves. It is in this analysis that the strengths and weaknesses in individuals and the company are revealed. Often the biggest errors that are made in developing a learning program are the assumptions made about the needs of the audience. An assumption is usually made based upon some preconceived idea as to where there is a lack of information and thus there is a need for training. It is for this reason that a needs assessment must be performed for a specific group, and it should be the first step in creating a learning tool to provide a quality training program. This analysis should contain three distinctive levels: organizational, task related, and personal analysis[6]

Organizational Analysis

It is important to secure the organization's stated objectives and to get a feel for the type of climate that is present. The environment effects not only managers' decisions, but just as importantly, the moral of each employee. Social-psychological factors may drastically affect and even prohibit training and education from succeeding.[7] Knowing where resistance to change may take place better prepares the training facilitator when developing a curriculum. The organizational analysis can be performed by meeting with the management team to obtain the company information such as regulations, objectives and company direction. Speaking with the employees can also provide vital pieces of information that describe the organization more thoroughly.

Determining where training and education is needed in an organization is an important element in the organizational analysis. Current policies and procedures can also provide a

great deal of information on how a company is dealing with current information allocation.[8]

Task Analysis.

A task analysis is concerned with precisely what jobs and tasks the employees feel are most critical for job success. A job description is the listing of specific things a person does on the job and exactly what is involved. The observable behaviors that are associated with the performance of a job are the task identifiers. The task identifiers simply break-down the total work that is performed into tasks. Once a job description is stated and divided into tasks, a course objective can then be determined. The course content defines the desired behaviors the trainees should possess at the completion of a training program. Without a working knowledge of what employees do and are expected to know, it would be impossible for relevant course content to be organized into a learning program (the course objectives and its component tasks will be further discussed in the Design Phase).

There are a variety of methods available to obtain job task details. By directly observing trainees on the job and tabulating how frequently they perform a specific task, accurate information can be gathered pertaining to what exactly the trainees do and how often. This method is referred to as time sampling and can be quite tedious and difficult if there are a number of trainees to observe.[9]

Another technique would be to verify the content of a job, through a job inventory, indirectly supplied by employees. The inventory can be brought about through an unthreatening, structured questionnaire. Employees know exactly what they do and do not

know; they also have a firm grasp on what it would take to make their jobs easier to perform. The content of the questionnaire should be to probe what employees think they should know to improve their job performance. A brainstorming session or a focus group can also bring about the same types of results as the job inventory. From the results of a focus group, a questionnaire can be generated and then given to all employees. When all trainees complete the survey, and the answers are tabulated; a comprehensive picture of job tasks should be quite clear.[11] An assessment of which skills the employees do not know will evolve. It is at this point where the next phase of the ISD Model would be accessed.

Personal Analysis

The third aspect of a needs analysis deals directly with the individual or "person." It is concerned with both personal facts and production figures. The information that is most desired in the needs analysis deals directly with employee perceptions of those things that are keeping them from making their strongest contribution to the organization. "The best practices in functional and technical areas serve as the basis for training in each of those areas. If you want to solve problems, identify where members of the organization should be and create training and development programs to lead them there."[12] It is in the personal analysis that job satisfaction can provide useful insight. It is common to use formal questionnaires generated from Human Resource professionals to acquire accurate information on employee job satisfaction. Interviews are also an excellent tool to gather or exchange information with employees. "Interviews are used to share information, solve

problems, persuade, appraise, screen, counsel, and reprimand."[13] Probing questions can be used to obtain the specific pieces of information that the interviewer needs. Crucial elements of a successful interview are making sure the agenda is well prepared and a good rapport is built early in the meeting. There are others avenues of securing a needs assessment: phone interview, written questionnaire, and focus group. Questionnaires minimize costs, and are fairly easy to tabulate. Focus groups were originally developed to gather marketing information on new and proposed products to determine how consumers felt about the products and associated services. They can be quite beneficial tools. The group setting creates a nonthreatening atmosphere, where people are not intimidated to participate.[14]

There are several methods of performing a needs assessment. Some are categorized as group processes and others as individual processes. There are advantages and disadvantages to both designs. Again, the type of analysis should be customized based upon the particular group that will be receiving the study. Without these special considerations, assumptions can lead to tainted output data.

Design

It is at this stage where the comparison of the present versus the desired stage of the company is compared and contrasted.[15] Once a needs analysis has been completed, an initiative can commence towards a corrective action plan; also referred to as the *Design* of the program. The tasks associated with this phase of the ISD model are to arrange the

critical areas of the program. The verified and approved job/task list serve as the input for the design of the program. The following steps are included in the design of a program:

- arrange job/task list into logical training cluster or sequence
- sequence learning objectives in a sensible arrangement
- categorize performance goals
- establish criterion measures
- create a set of goals for the program
- select training objectives
- establish trainer/trainee responsibilities
- develop tests
- set instructional strategy

If we are now achieving certain results and we want another result, then we must be precise in describing the gap or measurable discrepancy between the current and the desired outcomes.[16] It is imperative to distinguish between goals and objectives: it is quite simple to confuse them. Goals are the end results that we strive to achieve. They provide structured guidance towards accomplishing the mission. They are generally strategic in nature. Stated goals can be accomplished better when a person knows what is to be accomplished, and progress toward a goal should be measured in terms of the goal to be accomplished. Objectives define specifically how the goals will be achieved.[17] Objectives are observable and measurable. At this stage it is important to ensure that values, methods and ground rules are specified up-front. Objectives include:

- an input or condition
- how conditions are to be handled
- performance criteria
- disposition of the output or result of the action taken

Once the goals and objectives are clarified, training development objectives should be translated into performance terms. These terms describe what the trainee will be able to do, what the trainee is given or denied with the tools, working aids, assistance, supervision, and the physical environment in which he/she will perform. The performance terms will explicitly state the instructional intent, as well, they distinctly describe how sound the trainee must perform. Someplace in the terms, an acceptance level should be established so that the employees clearly understand the performance they must stay ahead of. To verify that objectives are met to the boundaries and terms stated, criterion measures must be developed. Quality control can be maintained through measures. Trainees can be tested through the use of criterion measures as well as testing the system to identify weak areas and their subsequent output.

The Design Phase also consists of the appraisal of staff resources and skills. It is important to determine what resources are available prior to the design of the program. Determine what is needed and what is available. The two lists should then be paired to conclude the resources that still need to be gathered. A training strategy, including a detailed timeline also fits within the scope of the Design Phase. Known elements such as breaks, meals, and facility limitations should be noted up-front. The schedule that is

determined for the trainees should take into consideration the time of day that people can learn the most efficiently and effectively." There needs to be a flow of energy. Mornings are great for theory and afternoons (or after lunch, when people start to get a slight bit sleepy) should contain activity."[18]

Again, course objectives define the desired behaviors trainees should maintain at the completion of the learning program. Objectives should be stated for each module of the learning program so that the trainees have a solid understanding of what is expected of them before, during and after each module. "Knowing where they are going will better help them get there more easily." [19] With each strategy consideration must be taken for the time, cost, facilities and number of students involved in the program.

Development

The Development Phase combines logistical elements of the program with personal details. It is in this phase where test objectives and course content are combined into a draft learning package. "This draft is subjected to formative evaluation to adequately assess its ability to deliver the requisite instruction."[20] There are many details that follow which include selection of the medium for delivery, review of the draft program and running a mock program with a sample group. The only sound business reason for offering a training program via one medium rather than some other medium, is that the medium selected is not only as effective, instructionally, as any other alternative, but it is also a more cost-effective way of addressing the problem at hand. [21]

Materials for the class such as handouts, pencils, markers, flipchart, etc. need to be decided. An introduction that includes restroom locations, break times and participation expectations must be planned. Selection of the training aids is equally important: overuse of aids complicate the learning process. "Instructional effectiveness is the result of the interaction of psychological effects with the requirements of the desired learning outcomes. They are the advantages that would have to be cited in support of any assumption of differential instructional effectiveness. To do otherwise, is to suggest that the 'delivery device' is a psychologically meaningful independent variable. It is not." [22]

The final output of the Development Phase is a detailed lesson plan. All of the information that has been obtained up to this point will be included in the lesson plan.

Production

The main function of the Production Phase is to validate, produce and distribute the final learning module.[23] Once the detailed lesson plan is completed from the previous phase, all of the details need to be completed so that the package transforms into a working tool. Some of these details include:

- establishing time allocations
- selecting instructional methods
- determining location/cost for the instruction
- evaluating the system in operation
- what contact will need to be made with the clients before, during and after the program

Evaluation

Evaluation means measuring something to make a decision, for example, to stop, modify, or expand a program to increase its benefits.[24] Analysis of test results by means of measuring central tendency, variation, reliability or the mean difficulty of a test and utilized these measures to engage in formulating favorable business decisions is an illustration of evaluation. However, evaluation can take a more simplistic form such as following up on graduates of a particular program. There are two forms of evaluation: formative and summative. Formative data deals with constant modification to a program, striving for perfection. Whereas summative evaluation uses data to make a final conclusion about the success of a program. Summative evaluation are often renamed formative when a final judgment of the data is made and a decision is made to continue the program with alterations for improvement.

While a program is being developed, the evaluation method should become an integral part of the planning process. There are preliminary questions that need be answered when establishing the evaluation procedures of a program:

1. What information are you trying to obtain?
2. Where in the company, will process have an impact?
3. How will the data be obtained?
4. How will the measurement be taken to obtain the desired results?
5. Does the capability exist to perform measurement procedures?
6. What decisions must be determined and where do the strengths/weaknesses reside in the measurement tools?[25]

Measures are critical tools: analysis in itself can be deemed irrelevant if the measures are not used correctly. "Measures drive behavior because feedback, rewards and punishments are based upon what is measured." [26]

Evaluation Measurements

There are four different methods of evaluation measurement shown in Table 1. There are advantages and disadvantages of each method of measurement. The determining factors that cause one method to be chosen over another should be derived from the data that is available in the particular evaluation study.

Table 1-Evaluation Measurements. [27]

Reactions -	how people feel about a program.
Learning -	whether people know anything as a result of a program.
Behavior -	whether people do anything differently after the program.
Results -	hard outcome measures of individual or organizational effectiveness produced by the program.

Reaction Measures include examples of overheard conversations and postcourse questionnaires that are used mainly for timely feedback. This information is beneficial in

formative quality control. The advantage of reaction measures is that they provide relatively fast feedback. If there is a problem, there would be plenty of time to fix it and allow the program to continue; however, this data should not be used to make predictions. There is not much control in acquiring the data and therefore reaction measures should not be used solely in making cost effective decisions.

In contrast, a learning measurement captures information on a change in knowledge, attitude or motivation. The most common tool used is a post-course test that measures knowledge content, attitude, and personality. The data obtained from this form of measurement method is quite advantageous in determining how much participants learned from the program administered. Unfortunately, the amount people know is not always in synchronization with what they do on the job. To combat this barrier, a post-course test should include on-the-job situation testing, so that behavior can also be taken into consideration.

Behavior Measures are probably the most difficult to work with based upon the complexity of gathering data. These measurement reveal whether or not participants behave differently because of a program. To get a true picture of whether the behavior of the participants has changed, the instructor should use a variety of sources to obtain data in support of each participant. It is recommended to get information from other sources in addition to the participants themselves. They often supply information they think they should be giving rather than the true facts. The data gathered through interviews or questionnaires will tend to be more valid if unobtrusive measures are taken. An example

would be to gather data but not include the participant's name. Organizational records serve to be a beneficial source. This information should be gathered both before and after the instructional program.

Results measures are the most often eye-catching figures to management since they include such data as sales, products, productivity, quality, costs, loss and turnover. "Bottom-line costs and benefits are the real measures of any human resources program."[28] The selection and creation of results measures are important. The success of the learning program and the understanding of the success relies on it. The significance of results measures is thus apparent.

Again, let the author state, that measures are critical tools and that all of the work put forth into analysis can be wasted if measurements are not used correctly. Spencer has stated that the basic results measurement is defined as outputs divided by inputs (benefits divided by costs).

"Training programs should be considered dynamic entities that slowly accomplish their purpose in meeting pre-designed objectives. Without systematic evaluation, there is no response to provide the information necessary to improve programs or quality information to make decisions."[29]

There is emphasis on using a very systematic procedure in all aspects of the training initiative. The more extraneous variables that can be controlled, the more valid the program becomes; however, limitations of the design must be recognized up-front. "Thus, the better experimental procedures control more variables, permitting a greater degree of

confidence in specifying program effects." [30] There are things that can take place that may corrupt or effect the validity of a study. These are often variables beyond the control of the researcher. There is no set procedure to alleviate external factors from entering a study; however, to be aware of these events is the first step in overcoming them.

Validity can be broken down into two categories: internal and external. The following chart briefly describes some of the possible internal and external variables that may be encountered during a study.

Table 2 -Types of Validity. [31]

Internal Validity	*History:* a specific event other than the treatment occurring between the first and second measure.
	Maturation: all biological or psychological effects that systematically vary with the passage of time (not including history)
	Testing: brought about because of the pre-test. Participants search for answers before taking the post-test.
	Instrumentation: caused by any means of change in how tests are scored.
	Regression: scores regress toward the middle of the distribution; natural law that all extremes tend to move toward the average.
	Regression toward the mean: natural law that all extremes tend to move toward the average.
	Selection: were the deck's stacked fixed or random or stratified
	Compensatory effects: did groups decide to get X of their own to beat out other groups.
External Validity	*Selection of treatment:* does X work only with certain groups of people; can try to validate program with subjects similar to those in the program.
	Setting and treatment: if X works in one place, will it work in others. can try to validate program in actual setting.[33]

Evaluation designs

There are a variety of evaluation designs. The specific design should be chosen based upon the sample, treatment and observation(s). No given design is superior in nature to any other: what makes them superior is the particular situation they are faced with. The notation for the evaluation designs are shown in Table 3.

Table 3- Evaluation Designs. [32]

X -	a treatment; training course sometimes called the independent variable because it can be manipulated.
O -	an observation.
OX -	pretest or baseline observation.
XO -	posttest observation "O" measures are dependent because changes in them depend on the "X" program.
R -	random sample.
S -	stratified "matched" sample.(*)
S R -	stratified random sample. (*)

* these control for bias and outside influences that may tend to "stack the deck"

Multiple Baseline (Wave Design). In a Multiple Baseline Design, the same training program is given to participants at different times. There are several reasons why this design would appeal to certain situations. It is quite difficult to apply the X (treatment) to more than one group at a time, even the best designed program will have a variation in when programs are given. Being able to stretch out the time when training is given allows

for all participants to receive the training. Another benefit is that each group acts as a control group for the group that is being tested. The data that is collected can be analyzed with this important fact in mind. The purpose of the Multiple Baseline is to determine if change in performance is due to the application of the program or if the change just occurred at the same time as the program.[33]

Before and After. Performance in the Before and After Design is measured before and after the training. The measures are taken on the job versus in the classroom. The difficulty in this design is that it is laborious to determine the exact reason for the increase or decrease in performance. A very detailed record must be kept of all changes that take place within the environment if the design is to be used.[34]

Pre/Post-Post Testing. This form of evaluation design measures for the performance increase/decrease after the training has been given to a specified group. It is difficult to determine when to provide each of these tests. A test should be given sometime before training is administered (pretest) and then another test should be given at the completion of the training (post test). This will measure the amount of change attributable to the training session. A second post test should be given some time after the training is complete. Comparisons can then be made between the pretest and both post tests to determine where significant differences take place. The variables must coincide with the objectives of the training program itself.

Any difference between the treatment group and the control group would be considered the benefit of the program. Problems do exist. By not providing training to all

groups, outside factors affecting one group and not the other can become destructive when time for analysis.[35]

Control Group. A design that contains one sample group that received a treatment and the other either receives nothing or a placebo is classified as a Control Group Design. This method allows for data with the treatment to be compared to determine the specific effects of the treatment (or lack of treatment).[36]

Table 4- Notation Chart for Evaluation Design.[37]

evaluation design	observation	treatment	observation	treatment	observation	treatment	observation
Multiple Baseline	01	X	02		03		04
	01		02	X	03		04
	01		02		03	X	04
Before & After	01	X	02				
Pre/Post Test	01	X	02		03		
Control Group	01	X	02		03		
	01		02		03		

Cost of Quality

True quality means continually reducing variation around a known target. This can also be defined in terms of service: consistently and continually meeting customer expectations and requirements. Essentially the researcher is speaking of the cost of quality as referencing the quick print industry and how service is directly related to the productivity of the color/copier operator. The cost of quality can be defined by events that take place within the company structure caused by:

- failure of the technology
- managerial situations
- lack of knowledge
- lack of understanding of what the customer wants and what the key operator understands of the customer requirements
- failure of the device[38]

By closing the disconnect (reducing variation) between the printing device and key operator, some of these events can be minimized. Human Resource intervention can lead to material and other outlay cost savings that can be claimed as benefits. [39] "All benefits come from the ways you make more money in business, that is: 1. increase revenues by raising prices or increasing volume and/or 2. decreasing expenses."[40] A major expense for a company can be lack of morale. Survey scores have indicated that low company morale directly relates to turnover, drop in sales and productivity. Another contributor to an increase in expenses is an excessive amount of downtime on printing devices. When the

cost of service, work done by hand and idle time is combined, it seems obvious to focus attention on reducing downtime. [41]

The cost of internal and external failure must be addressed. Internal failure costs are the costs occurring prior to completion or shipment of the product or furnishing of a service. External failure costs are the costs occurring after shipment of the product and during or after furnishing of a service.[42] An example of an internal failure cost would be a key operator detecting a bad page before it is delivered to the customer. There is a cost associated with fixing the defective page; however, if the page is delivered to the customer and the customer finds the defect, the cost will be much greater. Either the customer will lose faith in the business or they may even stop using the services at that particular location. The page that was delivered to the customer is an example of an external failure cost.

One further point that can not be ignored is the topic of learning. We often look at the training tool as being the objective; however, it is only a tool that is used to reach a desired learning state. "The goal of learning activities is to have all employees have ample learning opportunities in which to learn to do their job to the best of their ability and to seek new and better ways of performing this work." [43] Employees have the best sense of the types of knowledge and lack of knowledge they have on the job. They are the best judge as to the skills they possess and those they still need to acquire. Consultant Chuck Layne, has devised the ABCD approach to creating learning objectives:

A. Who is the audience

B. What behavior is expected

C. What condition is expected

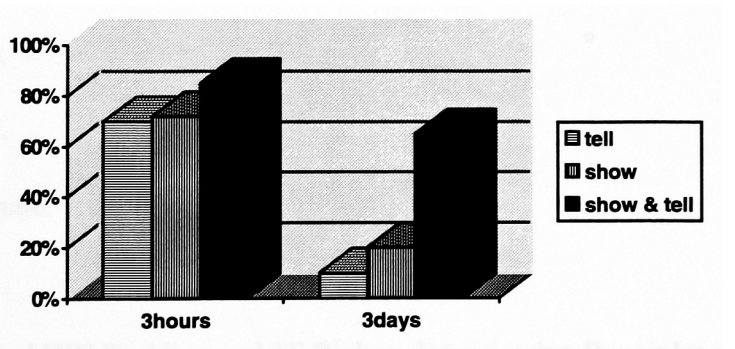
D. What degree of success is expected[44]

There must also be consideration as to how a learning tool is applied. People retain information differently depending upon how information is presented. The percentage of retained information diminishes over time. For example, by providing information through verbal communication (Tell), 70% of the information is retained three hours after it is provided; however, three days later, only 10% of that information is remembered. This is shown in Table 5 and Figure 1. People tend to recall more information long-term through a "Show and Tell" method. It has been tested that the combination of verbal communication aided with visual representation enables the percent retention to be optimized. Many factors must be considered in determining which method of training should be used for a program: cost, time, materials available and most importantly the needs of the participants. [45]

Table 5 - How Information is Retained. [46]

Normal Recall	3 Hours	3 Days
Tell -	70%	10%
Show -	72%	20%
Show & Tell -	85%	65%

FIGURE 1 HOW INFORMATION IS RETAINED. [47]



Endnotes

1. Deadrick, Diana, and Scott Dow. The Nominal Group Technique: Applications for Training Needs Assessment. Proceedings of the Sixth National Conference on Communications Technology in Education and Training. 1984, Silver Springs, Maryland.

2. Southworth, Miles. Training for Quality & Productivity. Quality & Productivity in the Graphic Arts. Livonia, New York. 1989.

3. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

4. Cantor, 18.

5. Baird, Lloyd, and Craig Schneier and Dugan Laird. The Training and Development Source Book Amherst, Massachusetts: Human Resource Development Press, 1983.

6. McGehee, Thayer 61.

7. Wesley, Latham 45.

8. Baird, 63.

9. Baird, 58-60.

10. Baird, 70-74.

11. Wexley, Latham

12. Baird, 28.

13. Goyer, RS, and WC Redding and JT Rickey. Interviewing Principles and Techniques. Dubuquet, Iowa, 1968.

14. Belasco, James, and Harrison Trice. The Assessment of Change in Training and Therapy New York, New York: McGraw Hill, 1969.

15. Kaufman, Roger. Identifying and Solving Problems: A Systems Approach. San Diego. California, 1979.

16. Kaufman, 33-41.

17. Xerox Quality Handbook. Leesburg, Virginia, 1991.

18. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

19. Cantor, 16.

20. Kaufman, 41.

21. Wise, Richard. Planning and Management. Silver Springs, Maryland: Information Dynamics Incorporated, 1984.

22. Wise, 47.

23. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

24. Spencer, Lyle M. Jr. Calculating Human Resource Costs and Benefits United States: John Wiley and Sons, 1986.

25. Spencer, 53-55.

26. Spencer, 72.

27. Goldstein, Irwin L. Evaluation Procedures

28. Spencer, 85-86.

29. Spencer, 23-24.

30. Spencer, 101.

31. Baird, Lloyd, and Craig Schneier and Dugan Laird. The Training and Development Source Book Amherst, Massachusetts: Human Resource Development Press, 1983.

32. Goldstein, 3-4.

33. Goldstein, 4.

34. Spencer, Lyle M. Jr. Calculating Human Resource Costs and Benefits. United States: John Wiley and Sons, 1986.

35. Baird, 47.

36. Baird, 31.

37. Baird, 79-81.

38. Juran, and Gryna. Quality Planning and Analysis. USA. McGraw Hill, 1980.

39. Spencer, 32.

40. Spencer, 32.

41. Juran, 3.

42. Spencer, 38.

43. Spencer, 38.

44. Layne, Chuck, Statistical Consultant, Richmond, VA. Personal Interview. 15 March 1995.

45. Development and Training. R.R. Donnelley & Sons. AGAT Conference. 1993.

46. R.R. Donnelley & Sons.

47. R.R. Donnelley & Sons.

Chapter Three

A Review of the Literature in the Field

There are several technological changes emerging in the Graphic Arts Marketplace: every segment of the market is vulnerable. To expound upon each change would lead to redundancy since they are related in some capacity or another. However, these transformations must not be ignored if an understanding of the waste, run length, total output and job satisfaction of a color printer/copier operator is desired. The following are brief descriptions of the most significant technological changes that are currently taking place in the marketplace, in the opinion of the author, and how they are impacting the industry.

Computers

Computer systems are directly effecting the progression and direction of the color digital printing industry. The emergence of faster, more powerful systems is changing the way in which color printed pages are being developed and who is doing the development. Relative affordability of desktop systems, including hardware and software, has increased the ease of access: an average computer can now be easily transformed into a professional desktop publishing unit. Those that own computers now consider themselves desktop designers, having the ability to effortlessly manipulate text and graphics. The unfortunate outcome of this easy access is that these new-found designers

do not have the knowledge or experience in designing and creating black & white or color pages accurately. The term WYSIWYG has become a common myth; however, computer users have not internalized its significance. Many still gaze in wonderment when the color image they see on their computer screen does not print exactly the same on their color copier/printer.

The most common computer used in the Graphic Arts Industry is the Macintosh. However, with the introduction of PageMaker, QuarkXpress and Corel Draw for Windows, there has been an increase in the purchases of Windows based personal computers for Graphic Arts use. The price of PC's initially made the transition more enticing with its apparent lower ticket price.[1] Recently more than one million copies of Windows '95 sold during the first week it was commercially on the market.[2] It is estimated that Microsoft may sell an additional twenty million copies by year end. There are estimates that say Apple has dropped to an eight percent market share with a majority of its units placed in the graphic arts market. With all of the hardware variability, the downfall of the surge of computer hardware/software brings with it many problems of compatibility, data integrity across platforms and incompatibility in color spaces. The novice user can face extreme difficulties if they have a handle on what they are doing.

Telecommunications

An advanced use of communications a few years back, was nothing less than utilizing federal express for an overnight delivery. Today, we have seen the use of telecommunications to send information across the world in a matter of minutes. The

increase use of fiber optics has lead to an expansion of data transmission over that of voice transmission. Data transmission has the flexibility of carrying either voice, data, image, or video signals. Obviously, as this technology experiences an increase in reliability, more services will be put to use. Not only can we listen to the morning world news, sending a full four-color image from NY to Chicago to Japan for the morning news is commonplace.

Not long ago, remote computing was difficult at best. With modem speeds topping out at 2400 bps, Federal Express arguably offered faster, more reliable data transfer than telephone wires. The combination of cheap, fast modems, and enhanced remote communications schemes has make remote computing both convenient and easy.[3]

Most telecommunications companies plan to build interactive TV systems over the next decade based on a super-cable TB model; one fiber optic cable connected to 500 or more homes via coaxial lines. Eventually, high speed networks based on one fiber optic cable for every six homes could supply enough upstream bandwidth to support interactive TV, elaborate information-on-demand services, high speed transfer to massive data files, and switched video communications on a single system. [4]

This past year has seen an enormous advancement in on-line services and the World Wide Web (WWW). John Womak has stated that "We will look back and see 1995 as the year in which on-line services and the Internet went from being niche 'toys' for 'computer geeks' to the start of becoming a normal aspect of everyday business." [5] Access into the on-line community has become an unrestrained entrance with the arrival of

various software packages that allow internet capabilities. The amount of information gathering, sharing and communicating is endless.

Desktop Publishing

The demand for color has been dictated by the extensive market restructuring: there exists a need to move to color applications in order to remain competitive. "The transition to color involves nothing more than expanding existing black and white systems instead of replacing them. [6]

The desktop publishing revolution has impacted the graphic design industry greatly. The number of in-home computers that have been converted to design and typesetting machines is astounding. These systems will infinitely challenge the high-end electronic publishing systems. The desktop publishing user has evolved from a novice into a sophisticated user. Typesetting and color prepress operations have gone through a complete overhaul. These market sections were previously saturated with highly trained specialists who worked on immense, expensive pieces of equipment. Currently the traditional typesetters of yester-year have been substituted by the many who work on the desktop. The breakdown of prepress work no longer exists. "The whole business of putting color on the page is about to undergo a paradigm shift." [7] In the authors opinion, this shift has already begun. Crafts people and professional typesetters are no longer necessary in prepress desktop publishing. With minimal experience almost anyone can create a page; the difference exists in the quality of work. Just because one can point and shoot a camera does not mean that their work is comparable to an Ansel Adams. With

time, vendors will push back much the control of the design and creative functions to their customers. [8]

Color Laser Copiers/Printers

Can black and white images be just as easily printed with color inks and toners? You were once able to place a black and white document on a copier and achieve decent quality copies: color is a much different situation. There are corrections, settings, and machine variables that must be controlled. The "ease-of-use" advertising of color copiers/printers can become somewhat deceiving.

"We've recently seen a tremendous growth in the development and marketing of desktop and networked color printers. The tools to create and produce color documents are no longer solely related to graphic artists and prepress professionals." [9] The advancements in color output are constantly improving in quality, speed, resolution and variety of throughput materials. These features directly challenge some of the high-end electronic publishing systems. The threat does not imply that the color laser copiers/printers will envelope the business of the high-end systems; simply the color copier/printers confront the ease of obtaining color output. Color is a vital part of our everyday life: we see, speak and hear in color. It is almost logical that the output we create can replicate this vision. Color output currently still resides within the Graphic Arts Market; however, this will change as the technologies become easier to access. "The most explosive growth will almost certainly be in the nascent "office color" market, where

color imagery, like type, will become another component of everyday business communication." [10]

There are a variety of color output devices available in the marketplace: inkjet, thermal wax transfer, phase change ink jet, liquid ink jet, pen plotters, color electrostatic, color dot matrix, color dry silver, dye sublimation, and color laser printing. The demand for faster turnaround time has put pressure on each of these printing devices to improve. "Users are not adapting color printing technology as quickly as or in the huge numbers with which monochrome printers were adopted. The reality is that education stands in the way of every user adopting color printing technology. The education I speak of is a basic understanding of color theory." [11] As unfortunate as it may seem, there is a widespread increase in the amount of printing that is being managed with minimal print production and print buying knowledge. The application of learning/training can greatly improve the way in which the printing industry is heading. "While traditional methods of prepress, proofing, and printing will not disappear for sometime, the trends are clear. Faster turnaround, lower-volume print jobs, and the ability to communicate electronically are the wave of the future in color publishing. Industry participants must adjust their thinking and publishing processes." [12]

Substrates

Documented communication is being redirected towards a new means of media: CD-ROM, the internet, digital cameras, multi-media and portable documents. Where does traditional paper output fit in this new era? Some believe there is a foreshadowing of the

renowned 'paperless office.' In 1980 the theory of the paperless office was significantly discounted: through the emergence of laser printers, photocopiers and fax devices: color page production increased by over 300% [13] This growth shows no pattern of slowing down over the next decade. There should be no direct threat to the traditional paper substrate as we know it; however, the use of many other possible substrates remains endless.

Printing

"Printing technologies will continue to evolve toward greater digitization, computerization, and automation. By the year 2000, nearly all prepress work will be computerized and presses substantially more automated." [14] The technologies will not change: an evolution of sorts better applies to this situation. In order for our printing industry to keep abreast of the upcoming changes, a conscience effort should be made to understand what our operators need to know in order to better assist them in their everyday work tasks.

There are many other topics this author has not even addressed: process control, color management, soy inks, and environmental issues to name just a few. Let it be stated that their absence does not indicate their lack of importance.

Combat of the Technologically Naive

Some believe that there exists a urgency "... to encourage the 'technologically naive' customer." [15] Looking at the specific knowledge-base of customers is a new way of

thinking for many markets. Customers have been educated through marketing and advertising, which up until recently, concentrated on product specific features. It was once stated by Bob Filipzyck when asked how to deal with customer education, "You can educate customers or 'idiot proof" their products." [16] However, is idiot proofing what we truly want to do to our products? With the complexity of technology, there needs to be a complete understanding of a product so that a user can confront any inconstancy that they may encounter. If a customer does not understand the functions of a product, they will only be productive when the product is functioning at or near 100%, with no variability. In reality, this is rarely the case: there is variability in the majority of technologies we use. "Customer education stems from the notion of customer anticipation. Good customer service no longer is enough to give a company the competitive advantage...we must anticipate customers' needs and deliver high-quality service" [17]

The first step that should be considered is to broaden our approach beyond the traditional ways business has taught. Structured learning can in deed be replaced with current innovations to meet the emerging technologies. [18] We currently live in a fast-paced, progressing society: thinking should take place outside of the box. Breaking the barriers of our traditional educational and training systems is not easy. Time and effort need to be put forth. As companies organize learning programs, the customer must still be viewed as number one priority in satisfaction. "The training program itself is a reflection on the company to customers, so it must portray an image of competence and professionalism." [19]

Potential Results

David Ulrich, direction of HR Executive Program at the University of Michigan Business School has stated that "a unity exists when customers and employees are jointly aware of, accept and act on a shared mind-set about the company... customer training can build the concept of a boundary's organization because by sharing management ideas, boundaries get removed."[20] If planned properly, both an organization and its training participants can gain from a learning program. "Through participation, the firm learns more about current and future customer requirements. This learning translates to the firm being more sensitive and responsive to the customer requirements."[21] There are a variety of outcomes derived from training: increased understanding of a customer's processes, forgoing joint commitments between the firm and customers, and stronger more solid relationships of trust between firm and customer.[22] It was stated in Fortune Magazine "Forget your tired old ideas about leadership. The most successful corporation of the 1990's will be something called a learning organization. Note: this is a learning organization, not a training organization."[23]

John Goodman, President of The Technical Assistance Research Programs has stated, "Up to 1/3 of all customer complaints are based on the customers not knowing how to use a product. This does not include those that bought for the wrong reason or those mistaken about what a product will do."[24] There needs to be some kind of program in place to introduce and assist customers through this technological transition.

Current Trends

"Most companies cannot wait for something to happen; they must make things happen. The survivors will be those who have the knowledge edge."[25] Recognition is continually growing in national and local associations that acknowledge advancements in training. Filipczak believes that "The idea is that you shape your customers' expectations by telling them exactly what the product will do, not what advertisements say it can do."[26]

Tom Schultz is the Vice President of Marketing for Great Lakes Litho. Joseph Schultz built and designed this printshop 60 years ago with only one lithographic press. Today, the company is noted for its sophisticated prepress operations. His success can be attributed to the creative learning programs that are apart of their operations. Tom stated, "It is fitting that technology has provided a powerful new tool for marketing and selling this array of advanced capabilities. Taking risks is dangerous only when you are working blindfolded."[27]

Sun Microsystems, Incorporated was experiencing a shortage of training courses that supplied their employees with critical work skills. Their response to their employees' needs was to double the number of training courses offered and increased the facility area of the training centers. From 1990 to 1991 the number of training centers doubled. Current computer skills such as administration, programming and networking were the first courses that were offered. [28]

Another major corporation, General Electric, initiated its customer education programs at the management Development Institute in Crotonville, NY not many years

ago. Customers as well as internal employees are welcomed into the programs. Personal as well as organizational relationships are easily formed. [29]

For some companies, customer education has been on their agenda for years. Fisher Controls of Marshalltown, Iowa is a manufacturing plant of control valves and automated control systems. Fisher has shifted their educational plans over the years to align with the current successful educational trends. For the past 50 years, Fisher has valued customer education. One of their recent strategies is to improve customer loyalty. They send all of their executives to training before allowing them to purchase a Fisher product. They have also made some classes a prerequisites for their technicians before servicing the product. There is an understanding that Fisher will inform and educate its employees and customers of the product upfront.[30]

Table 6 - Roles of Education and Training Through the Years. [31]

1960s Passive -	Respond to Training Needs Make Sure Classroom is in Order (lights, chairs, notebooks)
1970s Police -	Make Sure Training Programs are well Administered Make Sure Training Programs are well Attend by Employees
1980s Partner -	Ensure Trainees Learn Material that Impacts the Business Such as Team Building, Quality Make Sure Concepts Learned in Classroom Lead to Commitment & Action on the Job
1990s Pioneer -	Prepare and Deliver Training that Budges Boundaries between Organization and its Customers and/or Suppliers Involve Customers in Management Training, Team Building & Value-Setting Activities.

Endnotes

1. Fenton, Howard. "Electronic/Desktop Publishing." Technology Forcast 1993.

2. Womack, John. "1995's Digital Evolution." Instant and Small Commercial Printer November 1995:36.

3. Clark, Matt. "Remote Access Arrives." Macworld October 1994: 107-111.

4. Pilley, Charles. "Dream Net." Macworld October 1994: 96-106.

5. Womak, 36.

6. Kelly, Edward, and William Lamparter. "Industry Training and Education." Critical Trends for the 1900's A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry.

7. Fraser, Bruce. "Changing of the Guards." Aldus Magazine 1994.

8. Printing 2000.

9. Peffer, Paul. "For Position Only." National Association for Desktop Publishers. March 1995: 82.

10. Fraser, Bruce. "Changing of the Guards." Aldus Magazine 1994.

11. Peffer, Paul. "For Position Only." National Association for Desktop Publishers March 1995; 82.

12. Porell, Gregory. "Market Outlook: Technology Trends." Color Publishing Jan-Feb. 1995.

13. Harrigan, Barry. "Color Production, Simply Fundamental." National Association of Desktop Publishers March 1995: 5.

14. Printing 2000.

15. Bell, KR, and GEW Scobie. "Multi Media Technology, Banks, and their Customers." International Journal of Bank Marketing 10 (1992): 3-9.

16. Filipzyck, 31..

17. Matthews, Karen. "Customer Education: HR's New Approach to Better Service. HR Focus March 1993: 1, 6-10.

18. "A Timely Advantage." American Printer May 1992: 59-64.

19. Noel, James L., and Dave Ulrich and Steven R. Mercer. "Customer Education: A New Frontier for Human Resource Development." Human Resource Management Winter 1990: 411-434.

20. Matthews, 8.

21. Noel, James L., and Dave Ulrich and Steven R. Mercer. "Customer Education: A New Frontier for Human Resource Development." Human Resource Management Winter 1990: 411-434.Bray, Janet. "Work Force Issues." Technology Forcast 1993.

22. Noel, 411-415.

23. Bray, Janet. "Work Force Issues." Technology Forcast 1993.

24. Filipczak, 34-35.

25. Bray, 7.

26. Filipczak, 31.

27. "A Timely Advantage." American Printer May 1992: 59-64.

28. Johnson, Mary Fran. "Sun Service Aims to Shine." Computer World. 10 March 1992: 47.

29. Matthews, 10.

30. Filipczak, 34.

31. This, 26.

Chapter Four

The Hypothesis

Research Question

As was stated in Chapter One, this researcher had reason to believe that simplification of new printing technologies without exposure to the principles of printing, have a negative effect on the productivity of color copier/printer operators. As operators learn and retain more knowledge concerning the printing technologies related to their color copier/printer, their productivity on that device will increase.

Hypothesis

1.0 - An understanding of the principles of printing will increase the productivity of color laser copier/printer operators as measured by increased total output.

2.0 - An understanding of the principles of printing will increase the productivity of color laser copier/printer operators as measured by decreased waste.

3.0 - An understanding of the principles of printing will increase the productivity of color laser copier/printer operators as measured by increased job satisfaction.

4.0 - An understanding of the principles of printing will increase the productivity of color laser copier/printer operators as measured by output decreased job run-length.

Research Objectives

1. To develop a valid measurement instrument for determining the specific learning needs of the operators in the color laser copying/printing industry.
2. To identify the most practical/beneficial method of presenting the knowledge and skills to the operators.
3. To develop measurements that will be used to determine if a significant decrease in job run length, decrease in waste, increase in total output and increase in job satisfaction occurs due to the learning tool.

Limitations

1. Due to the number of individuals in the industry utilizing color copiers/printers, the sample size for this study will be determined by variability of the metric and significance level.
2. This study is concerned with the effects of education and training individuals and the resulting outcome; not with other factors such as internal employee problems dealing with company, family or lack of morale.
3. The measurement instruments gauge what they are presumed to measure.
4. Samples will provide accurate information throughout the study.
5. Owners and operators are willing to cooperate.
6. Reliability of devices are comparable (no bias on the level of service, all machines receive the same quality of service, machines run comparable copy volumes).

7. Test groups have a comparable level of knowledge of the subject matter.
8. The trainer/teacher can train/teach.
9. This researcher is assuming for purposes of this study, that what operators say is important to doing their job better is in fact what will enhance doing their job better.

Delimitations

1. A plethora of information will be obtained through the needs assessment and preassessment; however, this study will only be able to offer a leaning tool for those areas deemed the most critical, based upon limited time and money.
2. Due to the amount of information contained in the principles of printing, the subject matter of the learning tool will be limited based upon the pre-assessment study.
3. This study will only analyze those individuals working with a 300 dpi color copier/printer attached to a ripping device.
4. Many factors can affect the productivity of a machine (lack of interest of the employee, mechanical problems with the device, not enough employees to handle the work load and copy volume).

Chapter Five

Methodology

The methodology for this thesis project followed the basic framework of the ISD Model. However, the researcher customized various aspects to fit the needs and requirements of the participants, subject matter, and time frame of the study. Customers were engaged six weeks prior to the learning tool application. Data was gathered and documented four weeks former to learning tool application, immediately following the learning tool and then again, four weeks later. The learning tool was applied for a duration of a full work-day (or an equivalent of eight hours).

There are several users of color copiers/printers in the quick-print marketplace. In determining the sample size for this research, one of the major factors considered was the cost and process capability in which to conduct this program and to collect data while still having access to quality information. The magnitude of the research was such that it would have been impractical to deal with a sample that was greater than ten. It was also a challenge to obtain participants who fit the criteria:

- operating a color copier/printer
- having a desire to participate in the study
- having enough time dedicated to providing accurate data

Another consideration of operator participation was that they have similar output configurations and similar skill levels on their color copier/printer. This assisted in reducing variability in the collection of final output data. Ultimately, a sample of ten key operators were selected to partake in the study. The subsequent sections outline the procedures that were followed.

Analyze

From a developmental standpoint, this researcher needed to determine the customer requirements before supplying the mechanism by which the learning tool would be conveyed. Organizational, task and personal analysis took an extended period of time to complete, due to the irregular schedules of the operators and complexity in trying to establish a common meeting time. Initial meetings with the operators were centered around acquiring information about the organization, tasks and specifics concerning the operators themselves. One-on-one interviews were conducted and historical forms were completed (see appendix A) that provided a detailed look at the company's involvement with the color copier as well as training. The operators listed and then performed specific daily tasks for the researcher so that a clear understanding of related tasks were completely recognized. As well, each operator explained their major daily tasks as they relate to the color copier/printer. A summary is shown in Table 7.

Table 7- Daily Operator Tasks.

Walk up use of color copier	scanning straight off glass
	use of editing features when making copies off glass
	use of expert color settings to compensate for "bad" original
	selection of paper that optimizes the quality of the color copy
Network use of color copier	scanning original artwork on conventional scanner
	retouching of image to be printed
	manipulating image in application
	utilization of many printers and scanners to complete full job
	create own art work in computer to print on more than one device
	straight printing of customers' files
	converting file formats to print correctly
	editing old files and reprinting them
	selecting different colors to match pre-printed forms

The operators' technical skills were observed with a basic test/survey. The "knowledge" test was generated in the form of a questionnaire. Its content centered around basic printing theories and questions (shown in Appendix B). In addition to the print survey, a job satisfaction survey was given to establish the comfort level each operator had on specific job related topics (shown in Appendix C).

It was decided that the Pre/Post-Post Evaluation Design would be used as one means of measurement for this study. The advantages of this design complimented the reseach in that the operators needed to be tested directly after the learning tool was applied and then again after they had the opportunity to put their new skills to use.

Another advantage with the Pre/Post-Post Design was that this researcher could benefit from the results of the pre test to structure the learning tool more accurately.

From the tabulated results of the survey and the information obtained from the interviews, a mock list of "critical learning needs" was generated. This list was then broken down further with the assistance of the operators: they actually determined the most critical learning needs, which are shown in Table 8. This ensured that the training tool provided the details that the operators needed. The critical learning needs list was broken down to better utilize the training time-frame. Generally, people will not need to know all of the learning needs that may be specified as described by the analysis as illustrated by the Pareto Principle.[1]

One critical factor that was brought to the attention of this researcher after reviewing the historical overviews and daily operator tasks, was that this set of ten operators truly did not have a significantly high level of knowledge as it related to the operation of the color copier/printer. Their previous training was brief, if any. In the review of the critical learning needs with the operators, it was unanimously decided that they felt *basic* printing and color history were essential in the agenda for the learning tool.

Table 8- Critical Learning Needs.

Learning Needs Identified	Critical
1. An understanding of additive color theory	1. yes
2. An understanding of subtractive color theory	2. yes
3. The ability to color correct a hard copy original	3. yes
4. An understanding of the possible problems you can encounter printing color toner xerography	4. yes
5. Understand difference between process and spot colors	5. yes
6. Understanding of color mixtures and how this is similar or different on the color copier/printer	6. yes
7. An understanding of the expert settings on the color copier/printer	7. yes
8. An understanding of the differences between printing inks and toners	8. no
9. An understanding of color calibration	9. no
10. An understanding of color management	10. no
11. Principles of reflective scanning	11. no

Most of the operators had some way of tracking their jobs (internal and external), service calls and any problems they encountered. Additional information had to be obtained regarding the organizational and personal histories of the color copier/printers in order to track waste, job run length and total output. A tracking table was generated with each operator required to gather information on percentage of output waste and job run length. Additional information was gathered from the service company to validate the customer records and supply auxiliary information which is shown in Table 9.

Table 9- Daily Job Log.

Operator/Month	waste	problems	ave. run length	total output
1. October November December				
2. October November December				
3. October November December				
4. October November December				
5. October November December				
6. October November December				
7. October November December				
8. October November December				
9. October November December				
10. October November December				

Design

The results of the pre-study provided the author with the *facts* that were necessary to determine the learning tool. It was unanimous that all operators wanted a hands-on training session at their location or a common location. Their decision was strengthened by the fact that some of the operators had never been formally trained and they wanted to see and hear the information that was presented as well as be able to interact with questions along the way. To initiate the design of the training program, this researcher arranged the job task listing into an organized sequence. From this listing the goals and objectives were then determined. This information is shown in Table 10.

Table 10- Goals and Objectives.

Module	Goals	Objectives
Introduction	to introduce the learning tool, goals, objectives and answer any questions take care of any and all housekeeping (breaks, snacks, restroom facilities)	• to feel comfortable with the goals and objectives for the day • to understand the time constraints that the class will adhere to
One: How Colors are Produced	to recognize the two types of color and the implications they have with non-networked color digital devices	• to differentiate between spot and process colors • to be able to problem solve potential spot color problems • to be able to problem solve potential process color problems
Two: Color Perception	to recognize the components of color theory: additive and subtractive color	• to be able to name the subtractive colors • to be able to name the additive colors
Three:	to recognize the differing components that can effect	• to be able to list three elements that effect how a color is perceived

Color Effects	color	• to be able to avoid wasted output due to human perception of what good color is
Four: Color Controls	to recognize and operate with the special features that can be utilized in the digital color device	• to be able to color correct an image using color controls • to be able to observe changes in color output determined by color cast • to be comfortable with the controls on a device by understanding the basics of color control

Development

In the developmental phase, the draft learning package was created. The goals and objectives served as a guide in putting detail into each training module. The researcher wanted to stay focused on the subject matter so a basic guide of each module was provided. This acted as a means for taking notes during the session and a reference guide after the training session was completed. A decision was made to use slides, "show & tell" of the tangible reference material as well as the handouts so that participants would be able to follow the instructor during the training session.

Production

The Production Phase had its main objectives in validating the training session. A group of two color copier/printer operators were asked to critique the written class material as well as take the training class to provide feedback as to its strengths and weaknesses. This activity also provided an accurate tool to verify time allocations for each module as well as provide experience to the instructor.

It was determined on by the operators that the training session would be located at one of the key operator's place of business. The authorization to use the facility was made and the location was convenient for all parties. There was no direct cost associated with

the program other than time. The value of time in this study was the most expensive commodity.

The Production Phase consisted of an important milestone: the delivery of the training tool. Immediately following the learning tool, a post knowledge test was applied. The major content was similar as the first test; however, the phrasing of the questions was changed so that the operator did not answer the question based upon recollection of the previous test.

Evaluation

Evaluation Measurements. There were four evaluation measurements that were utilized in this thesis project. The evaluation portion of this study had begun the minute the first respondent shared a verbal comment regarding the training session. This type of measurement is described as a reaction measurement. It describes how people feel about a particular action or event. This input is extremely valuable and it was acquired during the introduction of the program.

The second measurement tool that was used is referred to as a learning measurement. The particular mechanism, a questionnaire shown in Appendix B, was used to determine if the participants actually learned as a result of the program. The "test" questionnaire was filled out immediately following the training program. Another questionnaire was completed by the trainees approximately four weeks after the training

class. The scores were then compared to determine if the learning tool had an effect on the operators.

All participants were asked to verbally and in writing describe the changes that each has made as a result of participating in the training program. Whether people do anything differently after the training program is measured with this behavioral measurement. This was, by far, the most difficult measurement to utilize for two reasons. The first is that this researcher had to rely on the operator to perform an additional task outside his/her daily responsibilities to document any behavior changes. The second difficulty was that this researcher had to rely on each operator to remain as honest as possible in filling out the information. This session was performed as a group in the effort to keep everyone honest.

As was described in Chapter Three, the results measurements are the most solid, because they represent outcome measures or effectiveness of the program. The results measurements that were used were for these findings total output produced by the machine, average job run-length and waste. Table 11 summarizes the specific means of measurement used to determine the results measurement for this research.

Table 11- Results Measurements.

unit being measured by operator	means of measurement
total output	meter reads, service records

average job run length	daily tracking log
waste	daily tracking log
job satisfaction	questionnaire

Evaluation Design. As was stated, the design that was selected for this study was the Pre-Post-Post Test. This design was chosen because it offered the best evaluation tool for this research. It consisted of an observation - treatment - observation - observation mechanism. The treatment consisted of the training session and each observation embodied a questionnaire.

Evaluation Statistics. Job Satisfaction, Print Knowledge, Waste and Total Output was measured utilizing the paired t-test.[2] Run Length was measured using a z-test statistic.[3]

Endnotes

1. Layne, Chuck. Statistical Consultant, Richmand, VA. Personal Interview. 15 March 1995.

2. Devore, Jay L. Probability and Statistics for Engineering and the Sciences. Monterey, California: Brooks-Cole, 1987.

3. Devore, 324.

Chapter Six

The Results

The purpose of this research was to analyze the effect of a special learning program on the productivity of color copier/printer operators. The hypothesis stated that an understanding of the principles of printing would increase the productivity of color laser copier/printer operators as measured by: increased total output, decreased waste, increased job satisfaction, and decreased job run-length.

It was agreed that each operator would be identified by an identification number to retain anonymity. The color copier operators had agreed to supply this researcher with the daily tracking forms and service records in order to have the necessary data to evaluate total output, waste, and job run-length. The completed surveys provided the data needed to analyze job satisfaction and the amount of printing information that the operators retained/used. Verbal feedback from the test participants and their managers throughout the whole process was utilized as qualitative data.

The first step in determining the effects of the learning tool was to ascertain the level of knowledge for each test participant after the tool was applied. The Print Survey contained thirteen true/false questions and eight fill-in-the-blanks (shown in Appendix B). The score of the survey was based upon a total percentage of correct answers; therefore, as the score increased, the better each operator performed on the test. Table 12 depicts the survey findings. The post-post test was distributed four weeks after the post test. This four week time-slot ensured the researcher that in effect the operators learned the material

and did not just memorize the answers to the test. According to the results of this measurement, the color copier operators did in fact increase their knowledge as a result of exposure to the learning tool. The pre-test vs. post_1 tests and post_1 vs post_2 tests both showed that the scores had a significant increase, and therefore the level of knowledge of each test participant increased as a result of the learning tool. The increased scores of the post_2 tests indicate that the operators not only learned as a result of the learning tool they also retained the information.

While not originally intending to look at the impact that time had on this study, this researcher has in effect shown that knowledge increased over time. I wonder how long this learning will occur before it plateaus? Was the learning stimulated from the learning tool alone?

These results were significant at the 95% confident level. Throughout the presentation of the learning tool, the operators voiced many comments regarding how much easier it was going to be to run the color copier/printer by understanding additive and subtractive color theory. They were astounded as to "how easy" the new-found information would make their jobs. At the time this researcher administered the post test_2, the operators were very excited about how much they had used the color copier and how much control they now had over adjusting the color controls. This information strongly supports the data acquired from the print tests.

Table 12- Printing Test/Survey Results.

	Pre Test	Post_1 Test	Post_2 Test
Operator 1	31	88	88
Operator 2	61	76	90
Operator 3	64	93	95
Operator 4	67	90	100
Operator 5	38	81	88
Operator 6	67	90	95
Operator 7	52	90	100
Operator 8	62	67	76
Operator 9	52	90	90
Operator 10	31	67	81

Pre Test to Post_1 Test

The average difference between pre and post_1 was 30.7. The standard deviation was then 14.9. At the 95% Confidence Level the difference between post_1 and pre test scores was significantly higher than 0; therefore the post_1 were significantly higher than the pre test scores. Thus, the overall hypothesis that an understanding of the principles of printing would increase productivity of a color copier/printer operator was accepted. The operators did significantly learn as a result of the learning tool and then applied that knowledge to increase their productivity as related to the operation of their color copier/printer.

Post_1 Test to Post_2 Test

The average difference between post_1 and post_2 was 7.1 The standard deviation was 5.2. At the 95% Confidence Level the difference between post_2 and

post_1 test scores was significantly higher than 0; therefore the post_2 was significantly higher than the post_1 test scores. Thus the hypothesis is accepted and the operators significantly improved their test scores proving that their knowledge increased significantly. The data also indicates that the time to apply their knowledge between post_1 and post_2 test has helped the operators to reinforce their knowledge and thus increase their level of knowledge. Thus, the overall hypothesis that an understanding of the principles of printing would increase productivity of a color copier/printer operator was accepted. The operators did significantly learn as a result of the learning tool and continued to learn after the learning tool was applied.

The next phase in establishing increased productivity of color copier/printers operators was to measure the total output, waste, and job run length.

Each operator had a daily tracking log with which to track the amount of waste per job and the job run length for the period extending the month before the application of the learning tool, the month of the learning tool and extending to the month following.. At the end of each month, the researcher obtained averages of amount of waste per month, average job run length and the total output per month.

As the data from Table 13 displays, the average amount of waste that was generated per month had significantly decreased after application of the learning tool. The operators verified the statistics in that they said they better understood how to setup the jobs and did not have to rely on printing test pages to optimize the output. A majority of

the operators also stated that when they did run into occasional problems, they had more of a capability to fix them.

The data in Table 13 lists the data collected on total output for each of the operators. These numbers were taken from the daily tracking logs and were then validated with the customer service records. It is interesting to note that the total output for each operator also increased after the learning tool was applied. In the qualitative information the operators said that they were not as afraid to use the device now that they understood more about it. They were more likely to run additional jobs on the device to test their skills on the information they just learned. The operators also stated that they were able to turn around jobs quicker because of the increased knowledge.

Due to insufficient quantitative data supplied by the participants, job run length was not measured by this researcher. The difficulties the operators said they had in obtaining the information on job run length was that they were relatively busy with customers, and they could not keep track of everything as they thought they would be able to. Despite not being able to reliably measure job run length, the average waste data strongly suggests that the average job run length did in deed decrease. A contributing factor was that lower amounts of average waste produced by each operator diminished the job run length. Further feedback from test participants suggested that operators felt more comfortable with the device. They stated that prior to this program, they would run more than what they actually needed. This allowed them to pick and chose among the bad prints which ones "were the best of the bad." This researcher must state that the participants did

not consistently record job run length; therefore, the data was not reliable for a quantitative analysis. However, the qualitative feedback suggested that the overall job run lengths did decrease. Thus the hypothesis that an understanding of the principles of printing would increase productivity as measured by decreased job run length was accepted.

Table 13- Final Daily Job Log.

Operator/Month	average waste	total output
1. October	128	1409
November	108	1479
December	120	1779
2. October	236	3239
November	118	4670
December	96	7659
3. October	92	1328
November	60	1433
December	58	1621
4. October	92	1328
November	60	1433
December	58	1621
5. October	161	1510
November	146	1619
December	67	1859
6. October	133	1643
November	102	1562
December	84	1449
7. October	167	1154
November	156	1188
December	140	1372
8. October	58	1252
November	102	1167
December	35	2190

Operator/Month	average waste	total output
9. October	169	4243
November	124	3789
December	88	5170
10. October	199	4239
November	131	4149
December	77	4369

Waste

The average difference between November and October was -32.8 with a standard deviation of 41.5. At the 95% Confidence Level the difference between November and October waste data is significantly lower than 0; therefore the amount of waste generated in November was significantly lower than in October.

The average difference between December and November was -28.4 with a standard deviation of 29.99. At the 95% Confidence Level the difference between December and November waste is significantly lower than 0; therefore the amount of waste generated in December was significantly lower than in November. The data collected an analyzed is in support of hypothesis 2.0. Thus, the hypothesis that an understanding of the principles of printing would increase productivity of a color copier/printer operator as measured by decreased waste was accepted. The operators did significantly reduce the amount of waste produced as related to the operation of their color copier/printer.

Output

The average difference between November and October was 114.4 with a standard deviation of 492.711. At the 95% Confidence Level the difference between November and October output data is not significantly higher than 0; therefore the November output is not significantly higher than the October output.

The average difference between December and November is 660 with a standard deviation of 933.638. At the 95% Confidence Level the difference between December and November output is significantly greater than 0; therefore the December output is significantly higher than the November output. Thus, the overall hypothesis that an understanding of the principles of printing would increase productivity of a color copier/printer operator as measured by a decrease in total waste was accepted. The operators did significantly increase the total output they generated on average per month on their color copier/printer.

Job Satisfaction

The last piece of this study was to access job satisfaction of the test participants though a survey containing a series of twenty four statements that had to be rated based upon the amount of stress they caused. The lower the total score, the amount of stress felt is decreased. It was presumed by this researcher knowledge gained through this organized educational tool would provide less stress leading to a higher level of job satisfaction. The job satisfaction survey suggested that upon completing the learning tool, the test participants' overall job satisfaction increased and participants were experiencing less job stress. The operators did state that their importance and self worth increased as a result of

the learning tool. They felt better about completing their work because it was not as frustrating as it had been when they did not understand how the device worked. Four of the operators even stated that they now spend extra hours at work "playing on the color copier" because they want to learn more about its functions. Table 14 displays the results of the questionnaire.

Table 14- Job Satisfaction Results.

	Job Satisfaction Pre	Job Satisfaction Post
Operator 1	**81**	**54**
Operator 2	**76**	**70**
Operator 3	**68**	**61**
Operator 4	**61**	**52**
Operator 5	**79**	**56**
Operator 6	**60**	**63**
Operator 7	**71**	**55**
Operator 8	**52**	**51**
Operator 9	**61**	**55**
Operator 10	**78**	**56**

Job Satisfaction

The average difference between November and October was 11.4 with a standard deviation of 10.1. At the 95% Confidence Level the difference between post and pre test scores is significantly higher than 0; therefore the post is significantly lower than the pre test scores. Thus, the hypothesis that an understanding of the principles of printing would increase productivity of a color copier/printer operator as measured by increased job

satisfaction was accepted. The operators did significantly reduce the amount of stress they reported on the job as as related to the operation of their color copier/printer.

Chapter Seven

Conclusions and Recommendations

The researcher's overall conclusion is that exposure to elements of the principles of printing do in fact increase the productivity of color copier/printer operators as measured by increased job satisfaction, decreased waste, increased total output and decreased job run length. It was very interesting to point out that the knowledge of the operators not only increased as a result of the learning tool, their knowledge continued to expand after the learning tool was applied (as proven in the Post-Post Test). This researcher wonders how long this learning will occur before it plateaus? Further, the knowledge that was increased in each key operator had created more satisfied employees. The operators were better able to perform their job tasks with less difficulties and improved the capabilities of their printing operations in the process. The operators were very pleased with the learning tool and all of its effects in their job performance. They were encouraged to seek answers to other questions that came of the learning program. Many of the operators commented that the program provided them with the starting point with which they began to build upon. Several of the management staff noted that motivation was instilled in the operators: they seemed to "just take off and want to learn more on their own."

The implications that this study could provide to manufactures of digital color copier/printers is significant. It has been proven in that the operators' devices were used

more productively and effectively as a result of the learning tool program. The training programs supplied by large corporations could earn a notable amount of money by providing course material based upon the needs of the customers. The outcome proves a win-win situation for the customer and company involved:

- more total output pages are created
- operators have higher job satisfaction
- less waste is generated
- total job run length is decreased

There were difficulties that were encountered in this study. Finding test participants that met the criteria and were willing to provide on-going data was a challenge. Scheduling of time with test participants in order to conduct the study on a consistent time frame was just as strenuous as getting data from test participants in a timely manner.

As a whole, this thesis program proved to be very interesting. The researcher was given the chance to provide data to operators who would not otherwise had the opportunity. Some of the other benefits were: to be able to see the inside operations of some very interesting color copier/printer operations, to see first-hand how the learning tool motivated operators and to see how the learning tool improved productivity significantly. The most significant aspect of this project was to experience and fully understand the difficulties involved with the operations of a field test vs. a laboratory

procedure. The researcher was at the mercy of the test participants which provided very real-life scenarios into this thesis project.

Again, this researcher has to ask if the learning that occurred after the learning tool was applied was stimulated from the learning tool alone or other factors inspired from the existance of the learning tool? It would be interesting to pursue this study to determine what can be developed or created to continue the learning process for each of these key operators.

Bibliography

Bibliography

1. Gandleman, David, and James Walsh. Accepting Change and the Training of an Industry Labor Force. Pittsburgh, Pennsylvania: GATF, 1992.

2. Kelly, Edward, and William Lamparter. "Industry Training and Education." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

3. Breeden, Wanda J. "How to Get Top Management Involved in Training." AGAT Conference, 1993.

4. Kelly, Edward, and William Lamparter. "Industry Training and Education." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

5. Bruno, Michael H. "Printing Process Trends." Critical Trends for the 1990's. A Report to the Graphic Arts Industry. December 1989. Research and Engineering Council of the Graphic Arts Industry. 23-27.

6. Filipcyak, Bob. "Customer Education: Some Assembly Required." Training December 1991: 31-35.

7. Breeden, Wanda J. "How to Get Top Management Involved in Training." AGAT Conference, 1993.

8. Berelson, Bernard, and Steirner. Human Behavior: An Inventory of Scientific Findings. USA: Haicourt, Cruse and World, Inc., 1964.

9. This, Leslie. "Results Oriented Training Designs." Planning and Management. Proceedings of the Sixth National Conference on Communications Technology in Education and Training. 1984, Silver Springs, Maryland.

10. Gandleman, David, and James Walsh. Accepting Change and the Training of an Industry Labor Force. Pittsburgh, Pennsylvania: GATF, 1992.

11. Good, HG. A History of American Education. New York, New York: MacMillan Company, 1962.

12. McMillan, Tom. "Technology Marches On." Color Publishing July/August 1994: 4.

13. Breeden, Wanda J. "How to Get Top Management Involved in Training." AGAT Conference, 1993.

14. Deadrick, Diana, and Scott Dow. The Nominal Group Technique: Applications for Training Needs Assessment. Proceedings of the Sixth National Conference on Communications Technology in Education and Training. 1984, Silver Springs, Maryland.

15. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

16. Baird, Lloyd, and Craig Schneier and Dugan Laird. The Training and Development Source Book Amherst, Massachusetts: Human Resource Development Press, 1983.

17. Goyer, RS, and WC Redding and JT Rickey. Interviewing Principles and Techniques. Dubuquet, Iowa, 1968.

18. Belasco, James, and Harrison Trice. The Assessment of Change in Training and Therapy New York, New York: McGraw Hill, 1969.

19. Kaufman, Roger. Identifying and Solving Problems: A Systems Approach. San Diego. California, 1979.

20. Wise, Richard. Planning and Management. Silver Springs, Maryland: Information Dynamics Inc., 1984.

21. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

22. Spencer, Lyle M. Jr. Calculating Human Resource Costs and Benefits United States: John Wiley and Sons, 1986.

23. Cantor, Jeffrey A. "A New Dimension in Military Instructional Development." Performance and Instruction 1988: 14-19.

24. Spencer, Lyle M. Jr. Calculating Human Resource Costs and Benefits. United States: John Wiley and Sons, 1986.

25. Juran, and Gryna. Quality Planning and Analysis. USA. McGraw Hill, 1980.

Layne, Chuck, Statistical Consultant, Richmond, VA. Personal Interview. 15 March 1995.

Appendices

Appendix A

Appendix A: Historical Information

	operator 1	**operator 2**	**operator 3**	**operator 4**	**operator 5**
equipment since	4/94	5/94	2/92	7/94	11/94
computers	PCs	Macs, PCs	Macs, PCs	Macs, PCs	Macs, PCs
apps	Ami Pro, Lotus, Word Perfect	Major Design Packages	Major Design Packages	Major Design Packages	Major Design Packages
prior training	minimal	full	basic	basic	none
back-ground	Administration	Printing	Photography	AV Communication	Printing
*comfort w/ device (1-5)**	4	2	3.5	3.5	5
					* with 1 being the most familiar

	operator 6	**operator 7**	**operator 8**	**operator 9**	**operator 10**
equipment since	6/94	12/92	12/92	4/93	6/94
computers	Macs, PCs	Macs, PCs	Macs, PCs	PCs	Macs, PCs
apps	Major Design Packages	Major Design Packages	Major Design Packages	MS Word, Lotus, Corel	Major Design Packages
prior training	none	basic	none	none	none
back-ground	Artist	Photographer	Computer Repair	Student	Communication
*comfort w/ device (1-5)**	5	3.5	5	4	4
					* with 1 being the most familiar

Appendix B

Appendix B: Printing Knowledge Test

Place a "T" for true or a "F" for false by each statement.

1. _____ The colors that you see on your computer monitor will match the color that you print on a color copier/printer.
2. _____ Blue, cyan, green, yellow, red and magenta are seen in the rainbow.
3. _____ Equal parts of magenta and cyan = purple
4. _____ My copier/printer can print Pantone Colors?
5. _____ A photograph viewed in my office will look the same when viewed in my customer's office.
6. _____ Colored paper has an effect on colored copies.
7. _____ Red + Green + Blue = Black
8. _____ When looking at a color copy, what you are actually seeing are hundreds of dots that fool your eye into thinking that you are seeing a continuous tone image.
9. _____ When looking at a photograph, what you are actually seeing are hundreds of dots that fool your eye into thinking that you are seeing a continuous tone image.
10. _____ Registration problems can occur anyplace where color adjoins.
11. _____ When scanning, the best images come from higher resolutions (or dpi).
12. _____ All papers print with the same quality in the color copiers.
13. _____ A red apple described by a person on the west coast will be described the same way as someone on the east coast.

Please fill in the blanks. If you do not know the answer, simply state that you do not know and go onto the next question.

1. Why? (to question #13)_____
2. Trapping compensates for what type of problem that you see when printing with your color copier/printer?
   _____
3. What is a Pantone Color?
   _____.
4. Name two elements that color is affected by._____.
5. If I move the color wheel on the color copier towards cyan, what happens?
   _____.
6. If I change the expert settings and increase the yellow, low setting to its maximum, what will happen to an image that is copied? _____.
7. What do I do when I see a color cast on all of my copies?_____
   _____.
8. What are three elements of the color copier/printer that you would like to learn more about?_____

Customer ID _____

Place a "T" for true or a "F" for false by each statement.

1. _____ The colors that you see on your computer monitor will match the color that you print on a color copier/printer.
2. _____ White light is made up of cyan magenta and yellow.
3. _____ Equal parts of magenta and cyan = orange
4. _____ My copier/printer can print Pantone Colors?
5. _____ A photograph will look different in an office environment vs outside in daylight.
6. _____ Colored paper has no effect on colored copies.
7. _____ The reason we perceive a flower to be cyan is because blue and green wavelengths of light are reflected from the flower.
8. _____ When looking at a color copy, what you are actually seeing are hundreds of dots that fool your eye into thinking that you are seeing a continuous tone image.
9. _____ When looking at a photograph, what you are actually seeing are hundreds of dots that fool your eye into thinking that you are seeing a continuous tone image.
10. _____ Registration problems can occur anyplace where color adjoins.
11. _____ A Pantone color is also referred to as a process color.
12. _____ All papers print with the same quality in the color copiers.
13. _____ Human perception is an element that will change color appearance.

Please fill in the blanks. If you do not know the answer, simply state that you do not know and go onto the next question.

1. Why? (to question #13)_____
2. Trapping compensates for what type of problem that you see when printing with your color copier/printer?
   _____
3. What is a Pantone Color?
   _____.
4. Name two elements that color is affected by._____.
5. If I increase the amount of cyan in my color balance what will happen to the red apple that is in the color sample?
   _____.
6. If I change the expert settings and increase the yellow, low setting to its maximum, what will happen to an image that is copied? _____.
7. What do I do when I see a color cast on all of my copies?_____
   _____.
8. Describe why WYSIWYG does not really exist without additional tools?_____

Customer ID _____

Place a "T" for true or a "F" for false by each statement.

1. _____ The colors that you see on your computer monitor are wavelenghs of Cyan, Magenta and Yellow.
2. _____ Color that is seen on a printed page is created through filters of RGB toner that filter the wavelengths of light to create a visual color.
3. _____ Equal parts of yellow and cyan = red.
4. _____ My copier/printer can print every Pantone Color that exists?
5. _____ The reason a photograph will look different in an office environment vs outside in daylight is because of the different illuminants.
6. _____ A picture of a blue sky will look differently if printed on yellow paper.
7. _____ The reason we perceive a pair of pants to be cyan is because blue and green wavelengths of light are reflected from the fabric.
8. _____ When looking at a color copy, what you are actually seeing are hundreds of dots that fool your eye into thinking that you are seeing a continuous tone image.
9. _____Calibration is not necessary when scanning images with different scanning devices.
10. _____ Trapping problems can occur anyplace where color adjoins.
11. _____ An example of a process color is the Pantone 148U.
12. _____ Red is an example of an additive color.
13. _____ Human perception and the surface of an object are elements that will change the way colors appear.

Please fill in the blanks. If you do not know the answer, simply state that you do not know and go onto the next question.

1. Why? (to question #13)_____.
2. Trapping compensates for what type of problem that you see when printing with your color copier/printer?
   _____.
3. What is a process color? _____.
4. Name two elements that color is affected by._____.
5. If I increase the amount of cyan in my color balance what will happen to the red apple that is in the color sample?
   _____.
6. If you change the expert settings and increase the yellow, low setting to its maximum, what will happen to an image that is copied? _____.
7. What expert setting control needs to be adjusted if there is a cyan cast on the color copies?
   _____
   _____.
8. Explain why WYSIWYG is not a true statement?_____
   _____.

Customer ID _____

Appendix C: Job Satisfaction Survey

This study is interested in obtaining information related to how you feel about things that may affect your job. Please use the scale below. Rate each specific question with a response that most accurately reflects the amount of stress that each factor causes you, if any.

1	2	3	4	5	6
none	slightly	somewhat	significantly	absolutely	does not apply

_____ 1.) insufficient knowledge about copier/printer
_____ 2.) lack of career path
_____ 3.) under staffing
_____ 4.) competence of co-workers
_____ 5.) quality of copier/printer
_____ 6.) insufficient technical training
_____ 7.) heavy workload
_____ 8.) customer frequently knows more about jobs than I do
_____ 9.) mistrust of management
_____ 10.) unresolved conflicts with coworkers
_____ 11.) outdated equipment
_____ 12.) my physical health
_____ 13.) financial security
_____ 14.) expectations regarding resolution of problems
_____ 15.) expectations regarding job completion time
_____ 16.) lack of authority to make decisions
_____ 17.) concerns of job obsolescence
_____ 18.) lack of experts as a resource
_____ 19.) difficulty in keeping up to speed with new technologies
_____ 20.) the frequency of service calls on copier/printer
_____ 21.) unrealistic customer expectations
_____ 22.) unclear customer expectations
_____ 23.) lack of tools (documentation, samples, manuals, examples, frequently asked questions)
_____ 24.) lack of time to complete projects that I would like to on the copier/printer

Customer ID # _____